RHIZOCTONIA ROOT ROT OF HOOP PINE.

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SUMMARY.

An outbreak of root rot of Araucaria cunninghamii Ait. in a forest nursery and an experiment aimed at its control are described and the nature of the causal organism is discussed. Inoculation trials with pure cultures of this organism are reported upon.

INTRODUCTION.

During April, 1935, a number of plants of hoop pine (*Araucaria cunninghamii*) were reported to be dying in the forest nursery at Googa in the Brisbane Valley, southern Queensland. The plants were two-year-old nursery stock planted in drills and the trouble at the time was confined to one nursery bed.

On inspection is was seen that the bark below the ground level on affected plants was in various stages of decay. The bark became loose and the tissues brown as far in as the cambium. In cases where infection was older, the bark stripped off the roots as the plants were removed from the ground. Plants were found which exhibited no above-ground symptoms of wilting, but which had a well-developed rot of the root system. It is quite common, however, for young hoop-pine plants to appear quite healthy above ground for some weeks after severe injury has occurred to the root system, such as that occasioned by root-pruning operations or by the attack of Scarabaeid larvae.

The trouble appeared first at one end of the bed and then began to spread along the bed. However, when examination revealed the presence of abundant fungus sclerotia on the surface of the injured tissue and many ramifying hyphae, suggesting the presence of a species of Rhizoctonia, preventive measures were immediately undertaken, and the nursery beds and paths were thoroughly treated with Cheshunt mixture, after which there was no further spread. A small outbreak was again experienced one year later, but a similar treatment effectively checked it.

In the same district, several dead plantation trees which had been put out from the nursery two years before exhibited the same symptoms as trees found affected in the nursery.

The same fungus was found on nursery plants at Kalpowar and Kilkivan in southern Queensland and at Atherton in northern Queensland. At Yarraman (southern Queensland) several deaths following transplanting from the seedling beds (at 12 months of age) into drills in the transplant beds were found to be associated with the same fungus. The greatest losses (up to 10 per cent.) occurred at Kilkivan where, at the Brooyar nursery, infection appeared in transplants which had been moved four months previously.

CAUSAL ORGANISM.

The infected roots of the plants show the superficial strands and hyphae of the fungus, which are brownish in colour. Infection cushions and black sclerotia are present and these appear to be produced by the internal hyphae

beneath the periderm. The sclerotia are small, being approximately 300μ in diameter. Specimens and cultures were forwarded to the Imperial Mycological Institute for identification. The Institute reported that the fungus was a strain of *Rhizoctonia crocorum* (Pres.) D.C. group. It is similar to an isolation sent there some years ago by Professor H. R. Briton-Jones from cotton roots in Trinidad, and very similar to specimens of a corticial root rot of tea seedlings forwarded to the same place by Mr. R. Leach from Nyasaland, where the fungus was the cause of considerable loss. It has also been recorded by the Institute on cotton roots from Tanganyika Territory.

Buddin and Wakefield (Rev. Appl. Mycol. VI, p. 756; VIII, p. 527, &c.) have shown that the perfect form of the western European strains is *Helicobasidium purpureum* (Tul.) Pat. The perfect form of the tropical strains on cotton and on tea in Nyasaland, according to the report by the Imperial Mycological Institute, is unknown, but Miss Wakefield found *H. compactum* Boedijn on specimens from South Africa. The species was originally described from Java (Rev. Appl. Mycol. IX, p. 562).

Specimens of a felty fungus occurring at and just above ground level were found in the Brisbane Valley in southern Queensland and at Banyabba in New South Wales. The fungus, in all cases save one in the Brisbane Valley, was growing on hoop pine. In the odd case it was on *Lantana camara*. Specimens of the fungus were forwarded to Dr. J. N. Couch of the University of North Carolina, who was working with the allied group *Septobasidium*. Couch reported that all the specimens were very like *H. compactum* but were not in fruit.

A subsequent specimen collected on hoop pine in the Brisbane Valley was a fertile one and agreed with the description of *Helicobasidium compactum*. This is of interest, as it is probable that this is the perfect stage of the causative organism of root rot in hoop-pine plants as described above.

The fungus *Rhizoctonia crocorum* was isolated in pure culture and 2-year-old hoop-pine plants were inoculated with the isolations. Inoculation was carried out just below ground level by wounding the cortex of the main root with a scalpel and applying some mycelium from the isolation in question. In other cases roots of naturally infected diseased plants were placed in the soil around the experimental plant. In some instances the plant was wounded and in others it was left intact.

In no case did any of the inoculated plants die, but on examining their root systems it was found that a number of the plants had been typically affected with the root rot but that they had survived long enough to produce new roots from near the soil surface and had lived on. This was probably due to the fact that in the glasshouse conditions under which the inoculations were carried out a high humidity prevailed. This disease after the preliminary attack apparently did not cause further damage in these experimental cases. This phenomenon would appear to be the same as that observed in the Brooyar nursery trial (see Table 2).

CONTROL.

Rhizoctonia root rot has not become of any major importance in Queensland forest nurseries because it is easy to control. In infected nurseries Cheshunt treatment has proved successful in routine operations, the procedure being to treat the beds which are observed to carry any infection and also the new beds prepared for the reception of any transplants.

Observation plots were laid out in the affected beds of the Brooyar nursery. The treatment applied was Cheshunt mixture at the rate of one gallon per square yard. The fungicide was prepared by thoroughly grinding together 2 oz. powdered copper sulphate and 11 oz. ammonium carbonate, mixing well, and storing in stoppered glass containers for 24 hours before use. For application 1 oz. of the mixture was dissolved in 2 gallons of water.

The results of the observations carried out at the Brooyar nursery are shown in Tables 1, 2, and 3. In these tables, plots 1 and 3 were treated with Cheshunt (normal mixture) whilst plots 2 and 4 were left untreated as checks. Treatment was carried out in February; the first observation was made four months later and the second seven months from time of treatment.

Table 1.

FIRST OBSERVATION OF CHESHUNT TREATMENT TRIAL. FOUR MONTHS AFTER TREATMENT.

Plot.	Treatment.	No. of Healthy Plants.	No. of Affected Plants.
1	Cheshunt	310	36
2	Check	249	68
3	Cheshunt	344	25
4	Check	331	54
Total	Cheshunt	654	61
	Check	580	122

Table 2.

SECOND OBSERVATION OF CHESHUNT TREATMENT TRIAL. SEVEN MONTHS AFTER TREATMENT.

Plot.	Treatment.	No. of Healthy Plants.	No. of Affected Plants.
1	Cheshunt	313	33
2	Check	264	53
3	Cheshunt	343	22
4	Check	325	55
Total	Cheshunt	656	55
	Check	589	108

The discrepancies between the counts for total numbers of Tables 1 and 2 are due to the inclusion or exclusion of plants on the border of the plots. The proportion of diseased to healthy plants in the treated plots as shown by

the two tables indicates that there was no further development of the trouble following the first observation.

At the commencement of the experiment all obviously affected plants were removed from the plots, but examination showed that a number of plants which were still healthy in appearance above ground were badly affected below. These plants probably would have died whether treated or not, since they were already infected before treatment. This would explain most of the deaths which occurred in the treated plots as shown in the tables, and if allowance is made on the basis of this reasoning by eliminating these plants at the commencement of the experiment the final figures for the observations would be approximately as shown in Table 3.

Table 3.

RESULTS OF CHESHUNT TREATMENT ON RHIZOCTONIA ROOT ROT, WITH CORRECTION FOR PLANTS AFFECTED PRIOR TO TREATMENT.

Period.	Treatment.	No. of Healthy Plants.	No. of Affected Plants.
First Observation	Cheshunt	654	0
	Check	580	68
Second Observation ..	Cheshunt	656	0
	Check	589	59

The figures indicate that the treatment prevented the loss of nearly 10 per cent. of the plants in the beds.

The experiment indicated that Cheshunt mixture is of value for controlling the disease. Results in routine treatments have borne this out. No foliage injury has been found associated with the treatment. The use of the fungicide at four times the normal strength has been shown to have no deleterious effect on the growth of hoop pine.

CONTRIBUTING FACTORS.

A number of plants were observed to have recovered from Rhizoctonia attack. These plants showed typical sclerotia on the surface of the roots but were making new root growth, indicating recovery. It was considered probable that the onset of the cooler winter weather in May would assist the plants in their resistance to the trouble. The disease is essentially one of summer occurrence; it has usually made its appearance during the early months of the year and so far has not been reported as initiating an attack during the winter. Whether infected plants which have withstood the attacks of the fungus during the winter would succumb during the following summer is unknown, but it is considered that this would happen in a number of cases.

The disease appears to affect weakened plants to some extent. This has been observed at the Yarraman nursery where, during one year, a considerable number of seedlings, which necessarily receive a certain amount of injury during lifting operations, died after transplanting at 12 months of age and were found to be infected with the fungus. In this nursery no deaths of established plants have been connected with the disease, though this has occurred in other localities.